



URBAN SANITATION AND PLANNING IN KHARTOUM AND OMDURMAN

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1. INTRODUCTION1.1 The Project

In 1980 sewerage studies were commissioned by the Sudanese Ministry of Public Works to initiate improvements in sanitation for the cities of Khartoum and Omdurman. The assignment contained the familiar elements of master planning, preliminary engineering and feasibility studies and required consideration of low-cost sanitation alternatives to sewerage.

First phase sewerage implementation designs were also to be prepared in the 12 month study period to support applications for funds.

Some conclusions reached by the project and the factors which led to these conclusions are summarised for reference when objectives are being established for similar commissions.

2. BACKGROUND2.1 Location

Khartoum and Omdurman are two towns in the three town capital conurbation of Sudan at the confluence of the White and Blue Nile river, 1200 km from the delta (Fig.1).

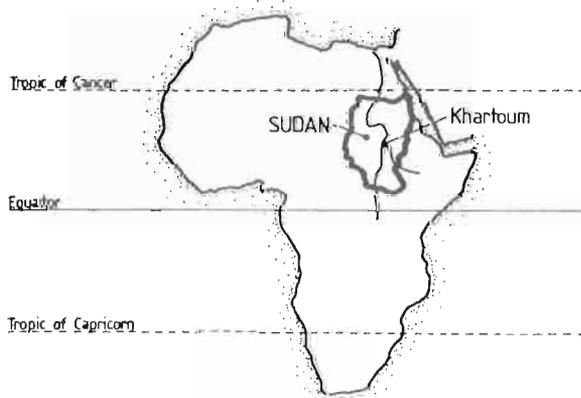


Figure 1. Project location

Sudan has an area of close to a million square miles and a population of 20 million. The capital is isolated and communication with the outside world relies on air transport and on a 1200 km road and 800 km railway line to the Red Sea at Port Sudan.

2.2 Economy and development

The country is poor: its natural mineral

resources are thought to be considerable but are virtually unexploited. Its agroecology is based on cotton in which production has flagged and on sugar, the potential of which is only just being realised.

The harsh climate, the economic situation and the enormous problems of infrastructure, particularly communication, present unusual and severe difficulties which beset aspirations to improve and develop.

In these circumstances, the allocation of resources to plan and provide sanitation ranks low on the list of urgent needs in the country. But the population of the capital is a million persons and rising fast, despite awareness of the need to limit, and efforts to prevent, rural to urban migration.

2.3 Physical development

Khartoum has developed as a rectangular grid on the flat alluvial plain between the White and Blue Nile rivers. It extends over an area of about 10km square.

Omdurman's street pattern is much more irregular, affected by the relatively pronounced topographical features based on four main wadis. The town is founded on varying thicknesses of consolidated alluvial cover over sandstone and basalt, which outcrops at the surface to the south and east.

Figure 2 shows the two towns in relation to the third, called Khartoum North. The centre of Khartoum is a mixture of low rise and moderately high government and commercial buildings but the bulk of development is of simple single-storey compound houses to the south, with higher class residential development closer to the centre and also to the east which is rapidly developing.

Omdurman is similar in its development pattern. The commercial area is centred on the Suq where the streets are characteristically narrow and congested. The old town has many irregular winding streets but newer areas are set out on a grid pattern, similar to the newer towns of Khartoum.

An area about 5km square at the centre of Khartoum was provided with modern sanitary sewers and sewage treatment twenty years ago, and the industrial quarter of North Khartoum more recently. No more than 100 000 persons

are served by these means. Some of the balance have septic tanks, but most have pit latrines of varying standards or nothing.



Figure 2. The three towns.

2.4 Population

Demographic statistics are dated, incomplete and varying in reliability. The main sources of information are in a development master plan dated 1975, a water supply master plan produced in 1979, a partial population census carried out in 1972, and relatively sparse contemporary planning and economic data.

Figure 3 shows predicted population curves for Khartoum, from three sources.

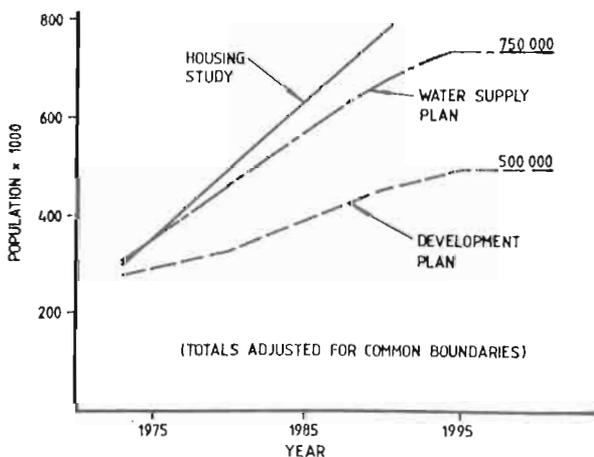


Figure 3. Conflicting population data for Khartoum.

Considered comparison of these sources concluded that the existing populations are 450 000 in Khartoum and 430 000 in Omdurman, rising to 790 000 and 780 000 respectively by the end of the century.

3. PLANNING CRITERIA

3.1 The client's requirements

The principal responsibility of the client government department was the design and construction of conventional sewerage systems and he expected the consultant to plan and design conventional sewerage and to propose

means of resolving the problems of the existing system. In Khartoum the Planning Authorities are actively trying to encourage prestige development and required extensions to the sewerage system to contribute to this end.

3.2 The consumer's needs and wants

It became clear that the most urgent problems were in the existing Khartoum sewerage system, which frequently overflowed into the streets; in liquid waste disposal from commercial and industrial areas in Omdurman; and in the absence of sanitation in the unplanned, largely squatter areas. Diarrhoeal diseases are already a major health problem and the risk of transmission in public places is high.

Present indications are that the proportion of the population with no satisfactory sanitation will increase. The relative attractions of urban living have caused a large rise in the squatter population. The authorities fear that the provision of services will encourage even higher numbers, creating a further drain on resources. General policy therefore is not to provide such services to squatters, but this is an expedience rather than a solution.

At the other end of the scale, although the national economic position is poor, there is substantial private activity, and considerable pressure from the more affluent for water and sewerage services to be extended. There is adequate water in the Nile to meet the former demand and the latter is partly a consequence of increasing usage linked with the high cost of building the deep soakaways necessary for the effective disposal of septic tank effluent.

3.3 Availability of capital funds

The consultants were told that capital funds should not be a problem and yet great difficulty was being experienced in finding funds for urgent water supply extension proposals, recently formulated. The dilemma is evident.

3.4 Public health administration, education and control

The Ministry of Health and the Municipalities have well established administrative systems, but many of the professional and artisan members of the community have taken better paid employment abroad and despite the efforts of the hard working remainder, the level of achievement clearly suffers. This poses a planning constraint which is difficult to accommodate realistically. Development projects rarely concentrate on programmes of education, training and control, for these are complicated by the interaction of many more social factors than are Capital Works construction programmes.

3.5 Selection of technical solutions

The most appropriate sanitation solution is that which is technically satisfactory at a purchase and maintenance cost the consumer is willing to pay.

The importance of lower cost solutions is becoming increasingly recognised and reported but long-term experience of successful, planned and engineered schemes is limited in comparison to experience of conventional sewerage. Social factors and education assume overriding significance. The problem of implementation and funding of the construction in such schemes is administratively complicated as the construction takes place entirely on the private property of individual householders.

The planning team have to select and design a reliable, long term system which will accommodate increasing flows of water as living standards rise. The design must be safe in all soils (a serious problem in Khartoum) and accommodate variations of construction methods or quality. Low cost systems require local trials and development and organisational changes before large scale implementation can be successful, which necessitates a longer term design commitment than a brief, close ended, planning and design project.

The critical questions which then arise are on the appropriate limiting capacities of each aspect of the system, the measures to be taken for each section of the community and how the scheme should ultimately be paid for. There are many ways in which country-wide tax payers effectively subsidise amenities for residents of the capital. These issues are highly complex and their resolution needs adequate data and a clear policy on resource allocation.

4. CHOICES

4.1 Conventional sewers

For both cities, sewers, pumps and pipelines offer the most reliable long term solution for large flows of liquid wastes from the commercial and industrial areas. The most interesting technical problem was set by the twenty year old sewerage system, constructed with asbestos cement pipes. A combination of favourable circumstances has minimised sulphide attack but it was decided that, as these may not last indefinitely, non-corrodible pipes should be used in vulnerable areas of future construction.

The greatest planning problems arose from the considerable lack of consistent, comprehensive planning data or policies. Best estimates had to be made. The final proposals for the sequence of sewerage of residential areas was a sensitive issue. Social and political aspects had to be balanced with technically based factors.

4.2 Treatment and disposal

Anti-pollution laws prohibit the discharge of effluent into the river Nile. There is however a strong requirement for the irrigation of eucalyptus trees for amenity and timber production.

For Khartoum it was confirmed that stabilisation ponds, such as those being constructed by the client, will provide the most appropriate form of additional treatment facilities where required, but that the existing resource of sound treatment works structures would be best used by refurbishment of the mechanical plant.

For Omdurman, ponds were designed to treat the bulk of the sewage, but special facilities are needed for oil mill wastes which are to be excluded from the public sewers and treatment works.

4.3 Operation

It became evident that problems with immobilisation of existing plant are not so much attributable to a lack of skills of mechanical and electrical fitters but to a severe shortage of parts and materials.

Designs and documents for new sewerage work aim to reduce maintenance requirements. For example, higher sewer velocities, submersible pumps and backup and by-pass facilities should reduce surcharging and blockages. Circuits and controls are kept simple and clear. The problems of organisation and resources are however not so amenable to "solution by specification".

4.4 Organisations

Responsibility for the existing system is split between Municipal and Health authorities, Khartoum North sewerage is operated separately. In contrast, power and water services are administered by a public corporation responsible for revenue collection as well as for providing a service for all three towns. The study concluded that some of the operational problems would be relieved by the formation of a single sewerage operation authority and ultimately by a public corporation responsible for both water and sewerage services. The design and construction of new sewerage works would however remain as an independent service. Detailed proposals were submitted for manning levels and tasks, such as those of maintenance terms, so that future operation and maintenance responsibilities would be clearer and easier to control.

4.5 Non-sewered options

The first study reports (Master Plans) showed that conventional sewerage is unlikely to reach large areas of the residential development in the foreseeable future (Fig.4).

Non-sewered alternatives were briefly examined showing the suitability of continued development of pit latrines and septic tanks. It was recognised that the intended sequence of planning reports were inadequate and so an additional report: 'Sanitation for Non-Sewered Areas', was produced.

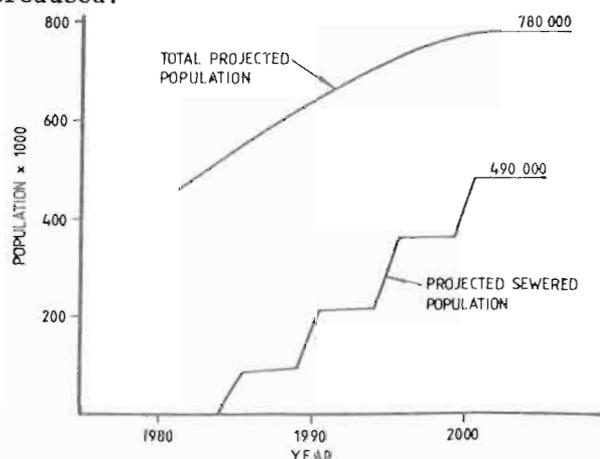


Figure 4. Projected total and sewered populations: Omdurman.

This report reviewed sanitation requirements including the need to improve septic tanks and soakaway design and their economic construction. The possible advantages of communal septic tanks were noted.

The report showed the need to provide economic safe pit latrines in the local social context, where for example men and women require separated facilities. For implementation, it was considered necessary to strengthen and build on the established experience of the public health officers; making changes gradually rather than immediately imposing new, locally untried, design and construction details.

A long-term programme of public education, advice and inspection was therefore proposed and costed in detail.

This programme would be preceded by a three year implementation project carrying out trials and training. After the first two years of the full-scale programme progress would be reviewed.

A preliminary draft was discussed in Khartoum with Public Health Education officers and local representatives of WHO and UNDP.

While every effort would be made to use Sudanese staff (at a salary level greater than government levels but far less than of expatriates) some imported expertise would be required. The initial three year implementation project is costed at LS 814 000 at 1980 prices. (The cost of minor sewerage for 28 hectares of a high class housing area with 144 plots.) (£1 = LS 1.9)

It was hoped that the long-term programme would serve up to 60 000 households at a

running cost of some LS 2 per household. The programme would not pay for latrine construction, householders would still have to provide their own. However the implementation project would confirm designs for appropriate latrine substructures in affordable price ranges. Local builders and suppliers would be trained in the improved techniques and designs.

4.6 Project feasibility

The question of project feasibility is liable to highly contentious and 'political' interpretation. It embraces the questions of can, will and should a project be commissioned and paid for, and by whom?

The planning team can only state a limited number of possible actions and their likely financial implications for the nation, the sanitation authority or the consumer: others have to take the appropriate decisions.

In Khartoum there are a large number of consumers using a sewerage system for no effective charge and so there is, in theory, a large reservoir of potential useful revenue.

If all consumers including government offices commerce and industry pay a charge based on about 3% of household income; if this revenue can be collected and properly used; if aid agencies could be found to fund the project on low interest terms; and if the projected costs in local and foreign exchange prove accurate; then the master plan conventional sewerage proposals for the two towns are probably feasible. Value judgements on the desirability of this are left to others.

5. CONCLUSIONS

5.1 Alternative priorities

The final emphasis of the project was on conventional sewerage; with low-cost techniques, stressing public health education as a supplement. An alternative approach to stress low-cost solutions with only essential conventional sewerage would have to have been decided before the Terms of Reference were prepared. Such a decision could still have been implemented by consultant engineers.

The resulting priorities would probably have been more difficult to satisfy and would have needed close co-operation between many different authorities. A longer study period might also have been required.

5.2 Role of the consulting engineer

At present while there is considerable emphasis on lower cost sanitation systems, the main body of established knowledge and experience of large scale sanitation is of conventional systems. This applies to engineers in both private and public sectors. Sanitation planning will increasingly demand

a multi-disciplinary approach. The future will show whether "engineers" have the training and ability to lead such projects. Firms of "consultant engineers" should have the necessary experience of using wide ranging expertise outside the resources of a single urban (or sometimes national) authority. Their experience of different problems and solutions should lead to a more

efficient use of resources. By recognising the critical factors which in practice influence the results of planning projects suitable directions can be taken in commissioning new planning and design projects. The most valuable work will arise from long-term co-operation between international expertise and local knowledge, and not from short-term studies.

SIMPLIFIED DATA RESUME

POPULATION PROJECTIONS

	<u>1973</u>	<u>1990</u>	<u>2000</u>
KHARTOUM (Principal Area)	300 000	707 000	790 000
OMDURMAN	280 000	630 000	780 000
KHARTOUM (Southern Area)			535 000
			<u>2 105 000</u>
ADDITIONAL ILLEGAL POPULATION MAY BE EXPECTED			(400 000?)

AREAS

KHARTOUM (Principal)	110 km ²
OMDURMAN	105 km ²

POPULATION DENSITIES

RANGE (Gross) 55 PERSONS/HA TO 160 PERSONS/HA

PERSONS PER HOUSEHOLD

1973 (Census)	6.2
2000 (Estimate)	8.2

ESTIMATED INCOME DISTRIBUTION

% OF POPULATION	2	7	30	50	75
EARNING LESS THAN: LS PER YEAR	300	600	1200	1800	3000

PROJECTED CHARGING BASIS

2.5% TO 3.5% INCOME

SEWAGE FLOWS: RESIDENTIAL AREAS

DOMESTIC	125 LITRES/HD/DAY
ALLOWANCE FOR LOCAL INSTITUTIONS	15 " " "
ALLOWANCE FOR FUTURE INCREASE	10%
TOTAL	154 L/H/D

MASTER PLAN TO YEAR 2001

	<u>CAPITAL WORKS</u> COSTS LS X 10 ⁶	<u>POPULATION</u>
KHARTOUM AND CENTRAL OMDURMAN	240	610 000
KHARTOUM AND FULL OMDURMAN	400	1 200 000

SANITATION PROJECT AND PROGRAMME

OBJECTIVES: RESEARCH; TECHNICAL IMPROVEMENT; EDUCATION; SUPPORT

	<u>DURATION</u>	<u>COST</u>
IMPLEMENTATION PROJECT	3 YEARS	LS 814 000
PROGRAMME	INDEFINITE	LS 135 000 PER YEAR
REVIEW	3 MONTHS	LS 60 000

STUDY TEAM

11 STAFF IN KHARTOUM FOR 8.5 MONTHS + LOCAL SUPPORT + VISITS + UK WORK